FLEX CEUs

Alzheimer's Disease and Exercise

Introduction

Alzheimer's Disease accounts for 60 to 80 percent of dementia patients. It is an irreversible, progressive disease that slowly destroys memory and cognitive skills, resulting in behavioral changes and physical decline. Most patients suffer from late-onset Alzheimer's, which begins in a patients' mid-60s. While rare, early-onset Alzheimer's occurs between a person's 30s and mid-60s. This disease is the most common cause of dementia amongst older adults. Sufferers of Alzheimer's can suffer from difficulty with movement and gait, and can gradually lose the ability to walk and perform activities of daily living. Physical Therapy plays a vital role in improving the lives of Alzheimer's sufferers by increasing activity, improving strength and flexibility, and improving quality of life.

Section 1: How Alzheimer's Affects the Physical Body

Alzheimer's disease is a progressive disease that causes brain cells to waste away and die. There is no treatment for Alzheimer's disease that can cure the disease. There are three stages of Alzheimer's, the early, mid, and late stages (sometimes referred to as mild, moderate, and severe in a medical context). Memory loss is the key symptom of Alzheimer's disease. It usually begins with difficulty remembering recent events or conversations in the early stages, progressing to the longest lasting stage where the symptoms are more pronounced and behavioral issues begin to occur due to frustration. In advanced stages of the disease, complications from severe loss of brain function, such as dehydration, malnutrition, and infection, can result in death. People with Alzheimer's may have the following issues with memory;

- Repeat statements or questions over and over
- Forget conversations, appointments or events, and not remember them later
- Routinely misplace possessions, often putting them in illogical locations, such as putting the car keys in the freezer
- Get lost in familiar places, such as local stores, or walking around the neighborhood
- Have trouble finding the right words to identify objects, express thoughts or take part in conversations
- Forgetting dates, needing notes and calendars to remember things
- Eventually, forget the names of family members and everyday objects.
- Difficulty with familiar things, such as how to operate a television remote or microwave

Although the exact cause of Alzheimer's is undiscovered, it is thought to be related to the abnormal buildup of proteins around and in brain cells. While the brain typically shrinks during the normal aging process, it does not lose neurons in excessive amounts. Alzheimer's disease however causes widespread damage and cell death. Alzheimer's typically destroys neurons and their connections in the parts of the brain involved in memory, including the **entorhinal cortex** and **hippocampus**. Later in the disease, it affects areas in the **cerebral cortex** responsible for language, social behavior, and reasoning. Over time as more areas in the brain are damaged, an Alzheimer's sufferer will gradually lose the ability to live and function independently. Eventually, the disease is fatal.

There are several changes in the brain in Alzheimer's patients. Brain changes may begin in patients up to a decade before symptoms begin. One change is that protein buildups known as amyloid plaques which can form between the nerve cells in the brain. Amyloid is a type of protein fragment, with beta-amyloid being a fragment of a protein taken from another protein called **amyloid precursor protein** (APP). In a healthy brain, these protein fragments would break down and be eliminated, while in a patient with Alzheimer's disease the fragments accumulate to form hard, insoluble plaques. These plaques destroy connections between nerve cells, or neurons, which causes those cells to die. The appearance of these amyloid plaques is what is believed to jumpstart the progression of Alzheimer's.

Neurofibrillary tangles also form in an Alzheimer patients' brain. Neurofibrillary tangles are found inside nerve cells, and are fibers that become twisted in the brain. They disrupt the transportation system inside the brain. They are made up of proteins called tau, which form part of a structure called a microtubule. The microtubule is a structure that helps transport nutrients and other substances from one part of the cell to another along axons and dendrites, which conduct nerve impulses away from the cell and towards the cell body, and these microtubule structures collapse in patients with Alzheimer's. Neurofibrillary tangles from inside of neurons and interfere with the cellular structures used to create and recycle proteins, resulting in cell death. ("The Progression of Alzheimer's Disease", 2010).

Neuroinflammation is a change to be expected in those with Alzheimer's. Evidence continues to prove that Alzheimer's disease is not solely due to neurological components but also has to do with immunological responses in the brain. It seems that **misfolded proteins** form into **aggregated proteins.** Misfolded proteins form into

amyloid plaques that clump together, or aggregate. They bind to pattern recognition receptors on **microglia** and **astroglia** in the brain, which in turn triggers an immune response. Microglia are **phagocytes** in the central nervous system which keep an eye on the brain for the presence of bacteria, viruses, or other microorganisms that can cause disease, while contributing to the maintenance of synapses to uphold plasticity of neural circuits. When the triggers are activated, the microglia migrate to the site of the issue. This causes the release of inflammatory mediators, which push along the progression of the disease and enhance the severity. In this instance, triggering factors promote the sustained activation of the microglia, which causes functional changes that eventually lead to neural degeneration. Microglia in the aging central nervous system of mice, rats, and primates shows enhanced sensitivity to inflammatory stimuli that is similar to that seen in microglia in brains with ongoing neurodegeneration. This is known as **priming.** The repetitive formation of amyloid plaques and the accumulation thereof, along with neuronal debris, activates a chronic, non-resolving inflammation.

Astroglia, also known as astrocytes, are star-shaped glial cells located in the central nervous system. Astrocytes are responsible for neuroprotection and recovery of injured neural tissues. Hypertrophic reactive astrocytes are commonly found upon post mortem human Alzheimer's disease tissue as well as in Alzheimer's animal models. Astrocytes are vital to maintaining links for transmission between nerve synapses. It appears that in Alzheimer's patients, astroglial atrophy is present which has a negative effect on this transmission process. The signs of atrophy appear first in the entorhinal cortex. When encountering amyloid proteins the astrocytes release **cytokines**, **interleukins**, nitric oxide, and other **cytotoxic** molecules which enhance the inflammatory response. Due to these continued triggers that encourage continued neuroinflammation, the damage caused by said inflammation does not have an opportunity to decrease and results in assisting the progression and worsening the severity of the effects of Alzheimer's.

These changes in the brain initially lead to memory issues. Early signs of the disease may include forgetting recent conversations, misplacing items, or forgetting where things are placed. Patients with Alzheimer's experience issues with aphasia, or a difficulty in finding the right words, and have trouble doing activities of daily living such as housework, yard work, driving a car, shopping, cooking, or paying bills. Alzheimer's patients may make poor choices in weather-appropriate clothing, forget food on the stove, or forget to take medications. As the disease progresses,

behavioral issues emerge due to some patients becoming worried, angry, or violent as a consequence of these cognitive issues.

In addition to cognitive issues, the Alzheimer's patient will begin to experience physical deficits.

Alzheimer's can physically present itself in the following ways ("The Effects of Alzheimer's", 2020);

- Loss of balance and coordination
- Shuffling or dragging feet when walking
- Trouble standing or sitting in a chair
- Weak or stiff muscles
- Fatigue
- Weight loss
- Coughing and choking
- Repetitive, compulsory behaviors such as picking or self-grooming
- Problems sleeping
- Difficulty controlling bladder and bowels
- Uncontrollable twitches or seizures
- Difficulty chewing and swallowing

Dementia inhibits the gait process due to the fact that it affects the areas of the brain responsible for movement and balance, resulting in the loss of mobility. Patients may begin to walk unsteadily, walk slower, and shuffle their steps. Turning and navigating obstacles will become difficult as a result. Ataxic gait, or walking that is characterized by the presence of abnormal and uncoordinated movements, is a common effect of Alzheimer's or dementia-related diseases and is characterized by unsteady staggering gait. This gait is evidenced by short, shuffling steps and loss of balance. Ataxic gait presents a danger to the patient due to an increased risk of falls and injury.

Muscle dysfunction is also a danger because it results in a general, fast decline. Weak and stiff muscles not only affect the patient's mood and worsen behavior, they put the patient at risk for falls and subsequent injury. Weak and stiff muscles cause difficulty with mobility, transfers, and normal activities. Muscles must be rehabilitated to improve the patient's quality of life and safety. Physical therapy can

be utilized to help rehabilitate patients who suffer from these side effects due to Alzheimer's disease.

Section 1 Summary

Alzheimer's disease is a progressive, mentally, and physically degenerative disease. Although the exact cause of Alzheimer's is unclear, it is shown to be marked by the formation of neurofibrillary tangles, neuroinflammation, and amyloid plaques. It may initially show symptoms of forgetfulness, ataxic gait, and confusion, which progresses to poorer gait, weak and stiff muscles, difficulty controlling bladder and bowels, and difficulty chewing and swallowing.

The role of the Physical Therapist and Assistant in treating Alzheimer's patients is to slow the progression of Alzheimer's symptoms, and treat the symptoms that have already begun to appear.

Section 1 Key Concepts

- *Aggregated proteins* - a biological phenomenon in which misfolded proteins aggregate, which means accumulate or clump together, either intracellularly or extracellularly
- *Amyloid precursor protein* (APP) - a membrane protein expressed in many tissues and concentrated in the synapses of neurons
- *Aphasia* - loss of ability to understand or express speech, caused by brain damage
- *Astroglia* - characteristic star-shaped glial cells in the brain and spinal cord, also known as astrocytes
- *Ataxic gait* - the presence of abnormal, uncoordinated movements, specifically in gait
- *Axons* - the long threadlike part of a nerve cell along which impulses are conducted from the cell body to other cells
- *Cerebral cortex* - the largest site of neural integration in the central nervous system. It plays a key role in attention, perception, awareness, thought, memory, language, and consciousness.
- *Cytokine* - any of a number of substances, such as interferon, interleukin, and growth factors, which are secreted by certain cells of the immune system and have an effect on other cells.
- *Cytotoxic* - something that is toxic to living cells

- *Dendrites* - a short branched extension of a nerve cell, along which impulses received from other cells at synapses are transmitted to the cell body.
- *Entorhinal cortex* - an area of the brain located in the medial temporal lobe and functions as a hub in a widespread network for memory, navigation and the perception of time
- *Hippocampus* - a complex brain structure embedded deep into the temporal lobe. It has a major role in learning and memory
- *Interleukin* - any of a class of glycoproteins produced by leukocytes for regulating immune responses.
- *Neurofibrillary tangles* - build ups of tau proteins, commonly known as a marker for Alzheimer's disease
- *Neuroinflammation* - inflammation of the nervous tissue. It may be initiated in response to a variety of cues, including infection, traumatic brain injury, toxic metabolites, or autoimmunity.
- *Microglia* - glial cells derived from mesoderm that function as macrophages (scavengers) in the central nervous system and form part of the reticuloendothelial system.
- *Microtubule* - polymers of tubulin that form part of the cytoskeleton and provide structure and shape to eukaryotic cells
- *Misfolded proteins* - a common cellular event that can occur throughout the lifetime of a cell, caused by different events including genetic mutations, translational errors, abnormal protein modifications, thermal or oxidative stress, and incomplete complex formations.
- *Priming* - a phenomenon when microglia demonstrate enhanced sensitivity to inflammatory stimuli
- *Tau proteins* - proteins that perform the function of stabilizing microtubules

Section 2: Screening Tools for Physical Therapists

As Physical Therapists and Assistants, the protocol for treating the Alzheimer's patient is much the same as treating any patient. Examinations are performed, history is obtained from the family and other clinicians, and assessment tools are utilized to help take measurements and gather data. Goals are determined, and a plan of care is decided to determine steps to take in order to reach those goals. It is still necessary to refer patients to other care team members such as Speech Therapists and Occupational Therapists as indicated to treat speech disorders, help with memory issues, assist with dressing, hygiene issues, and assist with performing other activities

of daily living. There is a significant shift in treatment needed for therapists to work effectively with people who are affected by dementia to properly treat them. The assessment and screening tools can be used to identify the patients' needs and discern the goals, and are distinctly different from the usual tools used for other patients.

Some useful tools to help Physical Therapists or other practitioners to screen for Alzheimer's disease. Amongst others, these include the **Mini-Cog**, **Mini-Mental State Exam** (MMSE), **Clock Drawing**, the **Six Item Cognitive Impairment Test**, the **Self Administered Gerocognitive Exam**, and the **Abbreviated Mental Test Score**.

The Mini-Cog is a three-minute test that can increase the detection of cognitive impairment. It consists of two components, a three-item recall test for memory and the simply scored clock drawing test. To perform the test, follow these steps;

- Look at the patient and ask them to listen carefully. Tell them that you will say three words that you would like them to try to remember. Some words used in clinical studies are;
    - Version 1 - Banana, sunrise, chair
    - Version 2 - Leader, season, table
    - Version 3 - Village, kitchen, baby
- After telling the patient the words, ask them to repeat them back to you. If the patient is not able to repeat the words after three attempts, move on to clock drawing.
- For clock drawing, ask the patient to draw a clock, then put in all of the numbers where they go. When that is done, ask them to set the hands to 10 past 11 o'clock. Instructions during this phase can be repeated. Move to three-word recall if the clock is not complete within three minutes.
- For the last phase, ask the patient to recall the three words mentioned in the beginning. Record the three words, and also the patient's answers.
- Scoring should be performed in the following way;
    - For word recall, the patient is awarded one point for each word spontaneously recalled without cueing. (0-3 points)
    - For clock draw, the patient is awarded two points for a normal clock. A normal clock would have all numbers in the correct sequence and the approximate correct position with no missing or duplicate numbers. Hands are pointed to the 11 and 2. (0 or 2 points)

- The total score is the word recall score added to the clock draw score. There are 0-5 points available. A score of less than 3 has been validated for dementia screening. A score less than 4 may indicate a need for further evaluation of cognitive status.

The Abbreviated Mental Test Score (AMTS) is also used to screen elderly patients for dementia. It is a simple 10 point test, with one point awarded for each correct answer, designed to be performed to gauge if cognitive issues are present. It includes these questions;

- What is your age?
- What is the time to the nearest hour?
- Give the patient an address. Ask them to repeat it at the end of the test, score one point if they are able.
- What is the year?
- What is the name of the hospital/facility or number of the home where the patient is located?
- Can the patient recognize two people, such as doctor, nurse, home help?
- What is the patient's date of birth?
- In what year did (significant historical events, such as 9/11, World War II) occur?
- Name the current president.
- Count backward from 20 down to 1.

A score of 6 or less on this test suggests dementia, although further testing is required to confirm.

The Six Item Cognitive Impairment Test (6 CIT) is another simplistic test. It should only take three to four minutes to complete. Scores of 0-7 are considered normal, while 8 or more are considered significant. It is a much newer test than the Abbreviated Mental Test, but is very similar. Ask the patient the following questions;

- What year is it? If the patient is incorrect, award 4 points.
- What month is it? If the patient is incorrect, award 3 points.
- Give the patient an address to remember with five components, such as John Smith, 34 School Street, Memphis.
- About what time is it (within one hour)? If the patient is incorrect, award 3 points.
- Count backward from 20 to 1. If there is 1 error, award 2 points. If more than 1 error, award 4 points.

- Repeat the address back to the therapist. For 1 patient error, award 2 points. For 2 patient errors, award 4 points. For 3 patient errors, award 6 points. For 4 patient errors, award 8 points. For all points of the question wrong, award 10 points.

There is a total score of 28. If the score is 0-7, the cognitive faculties are probably normal. If the score is 8-9, there could be mild cognitive impairment. If the score is 10 or more, there is probably significant moderate to severe cognitive impairment.

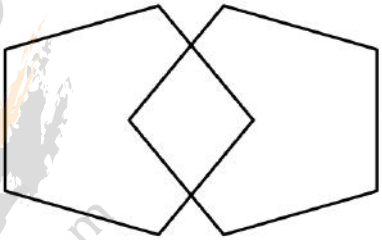
A useful test that can be performed by patients or families without the presence of a medical professional is the Self Administered Gerocognitive Exam (SAGE). The Self Administered Gerocognitive Exam is also known as the OSU Memory Test, as it was developed at the Ohio State University Wexner Medical Center. It is an easy to use tool that is fast and simple, designed to be used by people who are at risk for dementia or their family members before determining the need for a consultation with a physician. The questions include;

- Orientation questions, such as “What is the date?”
- Simple math questions, such as “How many quarters are in $1.75?”
- Short term memory questions, such as “What did you have for breakfast?”
- Naming items, such as “Write down the names of 12 different animals.”
- Problem-solving ability, such as “How are a car and a bicycle similar?”
- The clock drawing test.

If there are no incorrect answers, it is unlikely that the patient or family member needs to consult with a doctor. If there are incorrect answers, a consultation is advised. This is a test that can be repeated annually, every six months, or as needed to determine cognitive decline or dysfunction.

The Mini-Mental State Exam (MMSE) is a common exam used to test cognitive function, utilized by many health care professionals in varied settings. It is a thirty point questionnaire that includes tests of orientation, attention, memory, and language. Use the following tool to screen the patient. The questions should be asked in the order listed. One point should be awarded for each correct response within each section.

Maximum Score	Patient Score	Questions
5		What is the year? What is the season? What is the date? What is the day of the week? What is the day of the month?
5		Where are we now? What is the state, county, city, facility or building, floor or room?
3		Name three unrelated objects slowly and clearly then ask the patient to repeat back all three. Record the number of trials, trying to get the patient to learn them all if possible.
5		Ask the patient to count backward from 100 by sevens (93, 86, 79, 72, 65). Stop after five answers. An alternative is to ask the patient to spell WORLD backward.
3		Ask the patient to repeat the three mentioned words back to you.
2		Show the patient two simple objects, such as a pen and a clock, and ask the patient to name them.
1		Ask the patient to repeat the phrase, “no ifs, ands, or buts.”
2		Providing the patient with a piece of paper, ask them to take it in their right hand, fold it in half, and put it on the floor.

1		Provide the patient with a sentence, such as “Close your eyes”, and ask them to read it and do what it says.
1		Ask the patient to make up and write a sentence about anything. Must contain a noun and a verb.
1		Ask the patient to draw the symbol below. All angles must be present and two must intersect. 
30		Total:

The score should be determined as;

Method	Score	Interpretation
Single Cutoff	< 24	Abnormal
Range	< 21 > 25	Increased odds of dementia Decreased odds of dementia
Education	21 <23 <24	Abnormal for 8th-grade education Abnormal for high school education Abnormal for college education
Severity	24-23 18-23 0-17	No cognitive impairment Mild cognitive impairment Severe cognitive impairment

This test is a more in-depth test used to determine the possible degree of cognitive impairment. It can be

Section 2 Summary

Some useful tools to help Physical Therapists or other practitioners to screen for Alzheimer's disease include the Mini-Cog, Mini-Mental State Exam (MMSE), Clock-Drawing, the Six Item Cognitive Impairment Test, the Self Administered Gerocognitive Exam, and the Abbreviated Mental Test Score. Most of these tests are simple and designed to gauge cognitive decline or progression of said decline. They have many elements in common, including knowledge of orientation such as knowing the date, simple math, short term memory questions, problem-solving ability, direction following, comprehension, and motor skills. They are useful tools to gauge cognitive ability and determine the possible severity of the decline. They can be used upon initial examination and as follow up tools during and after the course of treatment. Adverse low scores (or high scores, depending on the test) on these exams are not necessarily indicative of dementia or Alzheimer's. Further testing is required if the scores reached are not desirable, these tools are just to identify possible dementia, which would make it possible for the Therapist to proceed appropriately.

Section 2 Key Concepts

- *Abbreviated Mental Test Score* - a 10-point test for rapidly assessing elderly patients for the possibility of dementia
- *Clock Drawing Test* - a simple tool that is used to screen people for signs of neurological problems, such as Alzheimer's and other dementias
- *Mini-Cog Test* - a 3-minute instrument that can increase detection of cognitive impairment in older adults
- *Mini-Mental State Exam* - a 30-point questionnaire that is used extensively in clinical and research settings to measure cognitive impairment
- *Self Administered Gerocognitive Exam* - designed to detect early signs of cognitive, memory, or thinking impairments, to be utilized by a patient or family member.
- *Six Item Cognitive Impairment Test* - a brief cognitive function test which takes less than five minutes and is widely used in primary care settings

Section 3: How Physical Activity Affects Alzheimer's

Physical Activity can have a positive effect on all patients, and it has been shown that people who are physically active are less likely to experience a decline in mental function and have a lowered risk of developing dementia disorders including Alzheimer's disease. Exercise has been shown to protect against Alzheimer's by stimulating the brain's ability to maintain old connections as well as fostering the development of new connections. A repetitive exercise program is especially helpful with Alzheimer's patients because the patient will not have to remember new steps or exercises, which will decrease the frustration that a patient will experience from forgetting or experiencing confusion. Therapists should keep in mind that exercise programs for dementia and Alzheimer's patients should be simple, repetitive, and safe, as problem-solving skills are compromised.

A regular exercise program can benefit those with Alzheimer's by improving physical issues such as;

- Balance
- Blood flow to the brain
- Flexibility
- Endurance
- Muscle strength

Improving balance is important to avoid falls, improve coordination, and promote joint stability. Balance is a largely unconscious skill which can be damaged with injury or mental decline. A form of proprioceptive exercise, balance relies on input from several of the body's systems including the;

- *Vestibular System* - part of the inner ear, the Vestibular System is a sensory system that is responsible for providing our brain with information about motion, head position, and spatial orientation. It is also involved with motor functions that allow us to keep our balance, stabilize our head and body during movement, and maintain posture. Nerve receptors in the inner parts of the ear such as the semicircular canals, the utricle, and the saccule, are sensitive to movements of the head and relay its position to the brain.
- *Visual System* - The visual system is composed of the eye and the part of the central nervous system which gives organisms the ability to process visual details as

sight. For balance, vision helps to adjust the body's position and steer around obstacles in the path.

- *Proprioception* - Also referred to as kinaesthesia, this is the ability of the body to perceive its own position in space. Receptors called **proprioceptors** in the skin, joints, tendons, ligaments, and muscles receive stimuli such as pressure which indicate the position, orientation, and movement of the body. This information is conveyed via the proprioceptors to the brain, which uses it to create a constantly updated map of your position.

There are several ways to improve balance in seniors with Alzheimer's. Exercises should be performed in a controlled environment with a Physical Therapist in close contact and use of a gait belt to avoid falls. Since balance exercises are meant to challenge balance, falls are highly likely if the patient does not have someone to steady them. Some simple starting exercises include;

- *Single-Leg Stance* - Also known as stork standing, this should be performed at a counter or behind a steady, solid chair. With the patient holding on to the back of the chair or edge of the counter, the patient should be instructed to raise one foot and balance on the other. The patient should hold this position for a predetermined amount of time or as long as they are able, then switch feet. The goal of this exercise is to improve the amount of time a patient can stand on one foot with a decreased base of support. The goal of the exercise is to maintain the center of gravity over the ankle.
- *Heel-Toe Gait* - Also referred to as tandem gait, this is performed with the patient on a flat surface and Therapist near or in contact. The patient should be instructed to place the right foot in front of the left so that the heel of the right foot touches the edge of the toes of the left. Move the left foot in front of the right, settling onto the heel and then shifting the weight to the toes. The patient should repeat these steps one way for approximately 20 steps or other predetermined distance, then turn and repeat the opposite way. This will not only make the patient's legs stronger but will challenge balance due to decreasing the patients base of support. In the beginning stages, the patient can practice this while gliding a hand along a counter or rail, and as their balance improves they can perform the activity without holding onto anything.
- *Foot taps* - The patient should again be placed on a flat surface with a sturdy piece of furniture, counter, or rail nearby to avoid total loss of balance. The patient should stand tall with feet hip-width apart in front of a step or low piece of furniture. One foot should be raised to tap the surface in front of them, then slowly

returned to the floor. The patient should perform 15-20 taps then repeat on the opposite leg.

- *Standing marching* - Standing in front of a sturdy chair, rail, or counter, the patient should be monitored for correct posture. The patient should lift one knee until the hip angle is as close to 90 degrees as they can, then return to the floor. This should be alternated between legs to promote weight shifting and improve proprioception.
- *Back leg raises* - Patient should be positioned in standing with proper support at a counter or rail. Keeping the knee as straight as possible, extend one leg into hip extension while maintaining posture. Holding the exercise for a predetermined length of time, return the leg to the floor and repeat with the alternate leg. This will assist in challenging the weight shifting and a smaller base of support. Alternately, patients can also perform side leg raises. With proper positioning and toe facing forward, lift one leg to the side and lower slowly. Repeat this either one leg at a time or alternating legs.
- *Side stepping* - Patient should be positioned in front of a rail or counter to provide support as needed. With feet together, the patient should step to the side while maintaining proper positioning and then move the alternate foot to meet the beginning foot. Repeat this for a predetermined length of time, then sidestep the other way.
- *Toe lifts* - To be performed at a steady place of support, patients should be instructed to raise themself up on their toes as high as they can then gently lower themselves. The patient should maintain proper positioning. To make it a bit more difficult, the patient can perform heel/toe lifts, or to raise up on their toes then rock back on their heels.
- *Head turns* - While walking with good posture, the patient should be advised to turn only their head to look over the left shoulder, then the right. This challenges the vestibular system due to head movements with walking. They can also incorporate looking up, then down, while walking. This targets your vision and vestibular system. It has been known to make some people dizzy. If this happens, stop the exercise, and try again with smaller head movements next time.
- *Seated exercises* - exercises such as ball toss, or other leaning and reaching activities, can be performed to improve seated balance, which is important in safe transfers and sitting on surfaces without support. The patient should be seated in a chair with arms for support if needed, and someone across from them. A softball should be tossed to the patient, who should be instructed to try to catch and throw the ball back. The patient should be encouraged to learn to avoid leaning too far to one side or the other so as not to overreach. This can be a good exercise to learn

the body's seated limitations with someone standing nearby. Batting a balloon back and forth can also be utilized.

- *Sit to stand* - Many patients fall while performing sit to stand or stand to sit exercises. The patient should be educated on body dynamics during transfers. To begin, start with a straight back chair with arms. Instruct the patient in pulling the feet back, placing the nose over the toes, and pushing up with arms on the armrests. To sit, instruct the patient to back up to the chair until the backs of the legs touch, place hands on the arms of the chair, and lower themselves slowly into the chair. As the patient progresses, they can practice sit to stand and stand to sit without armrests and from low surfaces.
- *Walking backwards* - This is simply performed while a patient is holding onto a rail or counter. Instruct the patient to slowly walk backward. This takes away the visual component of gait.
- *Balancing wand* - While in a seated position, provide the patient with a wand, light cane, or yardstick. Have them attempt to balance the wand on their hand while focussing their vision on the top of the wand. Ensure the patient does not get overzealous and lean too far from the chair. The patient can be encouraged to try balancing with the dominant or non-dominant hands, on the back of the hands, or both hands together. This can also be performed in standing with the therapist having a firm grasp on the gait belt.
- *Grapevine Walking* - With the patient holding onto a counter, they should walk forward while crossing alternating feet over the other. This is a harder one for those more advanced in balance training. This can also be performed while walking backward. The therapist should keep a firm grasp on the gait belt in case of tripping or loss of balance.

There are many more beginner's balance exercises than those mentioned. Feel free to incorporate non-traditional exercises, but remember to focus on simplicity due to cognitive impairments, and safety due to the age of those with Alzheimer's.

Many of these static exercises, which do not require the patient to walk, can be performed on a soft pillow or Bosu ball to increase the difficulty due to surface instability. Seated exercises can be performed on exercise balls to promote core strength and seated balance. Aside from **unstable surface training** using Bosu balls, pillows, or mats, mirrors can also be useful in balance exercises as a way to provide **visual feedback**. Visual feedback is a method used in rehabilitative practices where the attention of the patient is focussed on a mirror placed in front of them while they perform their exercises. Mirrors can also be useful to show a patient what exercises

they should be doing, how they are doing them, and to correct the motions the patient is performing. Both visual feedback and unstable surface training are proven to be effective and can be utilized simultaneously to improve the outcome of therapeutic interventions. It is advised to take part in training methods using visual cues, auditory cues, and tactile feedback to achieve **symmetrical load bearing**. Symmetrical load bearing is important to address the audio, visual, and tactile senses to assist in training the patient and to help those with dementia to retain the cues and instruction provided.

It has been shown that **cerebral blood flow** (CBF) is reduced in patients with Alzheimer's disease. The etiology of reduced cerebral blood flow remains poorly understood. It was recently discovered in mice models that neutrophils had adhered to capillary segments and blocked the blood flow to the brain. There are medications available to reduce the number of stalled capillaries, which has been shown to lead to an immediate increase in CBF and rapidly improved performance in spatial and working memory tasks (Cruz Hernandez, 2019). In addition to medications, exercise is important to improve blood flow to the brain in the normal patient. As the heart rate increases during exercises, blood flow to the brain increases. As the cerebral blood flow increases, the brain is exposed to more oxygen and nutrients. This results in improved brain function in patients with impaired functions.

Conversely, an interesting case study was performed by the University of Maryland with a control group of cognitively healthy older adults without cognitive impairments and with a group of seniors with **mild cognitive impairment** (MCI). Mild cognitive impairment is one of the strongest risk factors for dementia. People with mild cognitive impairment are at one in ten risk of developing dementia within a year. Each group participated in a 12-week program that consisted of 4 sessions 30 minutes in duration of moderate-intensity treadmill walking per week. During this study, changes in cerebral blood flow were measured in specific brain regions that are known to be involved in Alzheimer’s, including the **insula,** the **anterior cingulate cortex,** and the **inferior frontal gyrus.**

The control group showed improved cerebral blood flow in the **frontal cortex** of those patients with no mild cognitive impairment. Their performance on the cognitive tests were reported to be significantly improved. On the other hand, this new study showed that exercise was associated with improved brain function in adults diagnosed with mild cognitive impairment, by decreasing the blood flow in certain brain regions. As explained by Dr. J. Carson Smith, an associate professor in the Department of

Kinesiology, “A reduction in blood flow may seem a little contrary to what you would assume happens after going on an exercise program, but after 12 weeks of exercise, adults with MCI experienced decreases in cerebral blood flow. They simultaneously improved significantly on their scores on cognitive tests.” (Exercise Benefits Brains, 2019).

It is purported that for patients beginning to experience subtle memory loss, such as at the beginning of Alzheimer’s, the brain is in a type of crisis mode and may try to compensate for low functioning by increasing cerebral blood flow. Although heightened cerebral blood flow is normally beneficial to brain function, there is evidence to suggest that it may actually further the progression of memory loss in those diagnosed with mild cognitive impairment.

Amongst patients with mild cognitive impairment, cerebral blood flow was decreased in the left insula and in the left anterior cingulate cortex, which appeared to correlate with improved performance on a word association test used to measure the subjects’ memory and overall cognitive health. This seems to indicate that exercise can impact biomarkers of brain function by decreasing the cerebral blood flow and may help to protect patients by preventing or helping to postpone the onset of cognitive decline. This fascinating study explores the ways exercise specifically affects those experiencing cognitive decline, and although it may not be in the way previously believed, exercise continues to be of great benefit.

This being said, it can be difficult for senior adults to maintain appropriate mobility. Muscles and joints weaken, while the range of motion and energy levels decrease. Due to these factors, flexibility can begin to decline. Poor flexibility means more difficulty when performing activities of daily living and can result in joint stiffness, muscle tightness, lower back pain, increased instances of loss of balance, and postural issues. Stretching is vital to help fight poor flexibility and the associated decline of function by improving elasticity in the hamstrings, quadriceps, and the lower back, and to improve mobility in the hip and knee joints. This improved elasticity is important in the continued mobility of the patient and the prevention of falling in senior adults.

As a person ages, the water content in connective tissues such as tendons and ligaments decreases. This results in reduced flexibility, which is hazardous due to the limits in the range of motion causing instability and decreased movement, which in turn results in weakening of the muscles. Tendons and ligaments will begin to tighten

due to habitual posturing, which can result in knee extension deficits, stooped posture, and hip immobility. Flexibility can be improved with simple stretches, while coordinated strength training will help to strengthen the weaker muscles and correct poor flexibility and postural abnormalities.

Stretching can also increase blood flow and energy levels, which are beneficial for the following reasons;

- Increased blood flow promotes improved wound healing, provides white blood cell transportation throughout the body which decreases the risk of infection,
- Escalated circulation allows proper functioning of lungs, heart, and muscles
- Increased blood flow allows the transportation of white blood cells around the body as needed to help fight infection.
- Improved circulation helps stabilize body temperature, which is important in the elderly as they tend to have more difficulty regulating body temperature.
- Heightened energy levels mean that daily activities may be less tiring and that the patient will feel more motivated to engage in daily activities.
- Improved energy levels promote increased social interaction, as the patient is more likely to feel like getting out of their home and exceeding their normal activity level

There are two types of stretching, **dynamic stretching** and **static stretching**. In younger populations it has been shown that dynamic stretching enhances muscle activation levels, however not much study has been performed on the differences between static and dynamic stretching in older adults. In one such dissertation provided to the School of Health Sciences, thirteen healthy women between 60-75 years old completed dynamic and static exercises of the gastrocnemius and soleus muscles. It was proven that static stretch increased soleus muscle activity during the balance activity tests, while dynamic stretch increased sway with eyes closed on a soft surface. The study concluded that static stretch is more beneficial, as it immediately improves muscle activity within the stretched muscle, and that dynamic stretch was related to an increase in fall risk post dynamic stretch. This is something to consider when working with those with Alzheimer's, as static stretch may be more beneficial and effective for those with balance issues.

There are many ways to incorporate stretching into the exercise program of an older adult in low impact ways. All stretching should be slow and considerate of the patients' physical limitations. Stretching allows for greater movement in joints and improves posture. Stretching is important to help to release muscle tension and

soreness after exercising, and reduces the risk of injury prior to performing more intense exercise. It may also help increase circulation, improve muscle control, and have positive effects on balance and coordination. Consider adding in elements of Tai Chi, Pilates, Yoga, or water therapy to provide some variety and structure to the exercise programs. Exercise videos are helpful to assist in focusing during stretching exercises or strengthening, and add an element of enjoyment to the therapy session.

As a person ages, the endurance level begins to naturally decline. Patients may begin to have difficulty walking up stairs, going shopping, performing chores around the house, or even just walking around. Endurance training is crucial to build energy, as it increases the breathing and heart rate, improves the health of the heart and lungs, and improves circulation. It also has positive effects on mood. Endurance exercises for seniors include brisk walking, low impact aerobics, swimming, water aerobics, cycling, or just any exercise that makes someone breathe faster and their heart rate increase. Endurance exercises should be performed at least two times per week for seniors. Improved endurance and stamina result in less physical dependence on others.

Strength training is a vital part of an exercise plan for any senior. Strength training is a type of physical exercise that requires repetitive contraction of the major muscle groups against an opposing force, such as the use of free weights, resistance bands, or by using gym equipment. It has many benefits, including;

- Assists with weight management, to help prevent them from gaining weight and loss of mobility and numerous health issues associated with weight gain.
- Reduce the symptoms of osteoarthritis, diabetes, osteoporosis, back pain, and depression.
- Improves balance, reducing the risk of falls and injury.
- Increases strength and muscle mass, to prevent progressive weakening and weakness related issues.
- Promotes independence, which is beneficial for the patients' state of mind and to help take the burden off the caregiver.
- It helps the patient to sleep better, which can be an issue in the elderly as those with Alzheimer's tend to nap more during the day and stay up at night.
- Improves glucose control for those with diabetes.
- Enhances bone density, which decreases the risk of bone fractures and breaks.
- Increases reflex and reaction times, which can result in fewer falls or other incidents.

- Raises metabolism, which results in better calorie burning.
- It improves functional movement, which is beneficial to improve mobility, walk further, and can reduce the need for assistive devices like canes and walkers. Improved functional movement also helps with transitional movements, like sit to stand and stand to sit transfers, bed mobility, car transfers, and tub transfers.

Section 3 Summary

A regular exercise program is beneficial to seniors with Alzheimer's, and can have a positive effect on balance and stability, endurance, flexibility, mood, improved blood flow to the brain, and promotion of muscle strength. has been shown that people who are physically active are less likely to experience a decline in mental function and have a lowered risk of developing dementia disorders including Alzheimer's disease. Stretching is important to perform while exercising to maintain flexibility and avoid injury from exercise. Exercise has been shown to help maintain the links in the brain as well as helping to build new connections and promote neurogenesis and is proven to help delay and even prevent the cognitive decline associated with Alzheimer's and dementia.

Section 3 Key Concepts

- *Anterior cingulate cortex* - the the frontal part of the cingulate cortex that resembles a "collar" surrounding the frontal part of the corpus callosum. The anterior cingulate cortex (or ACC) has been implicated in several complex cognitive functions, such as empathy, impulse control, emotion, and decision-making.
- *Cerebral blood flow* - Cerebral blood flow (CBF) is the blood supply to the brain in a given period of time.
- *Dynamic stretching* - a strategy used to improve flexibility while moving through a range of motion.
- *Frontal cortex* - located just behind the forehead, it is the biggest cortex lobe. The frontal cortex plays an important role in problem-solving, planning, impulse control, reasoning, as well as controlling emotions, and behavior.
- *Inferior frontal gyrus* - part of the frontal lobe, this is the location of Broca's area, which is involved in language processing and speech production.
- *Insula* - a small region of the cerebral cortex located deep within the lateral sulcus, which is a large fissure that separates the frontal and parietal lobes from the temporal lobe. The insula plays a significant role in pain perception, social engagement, empathy, emotions, and numerous other vital functions.

- *Mild Cognitive Impairment* - Mild cognitive impairment (MCI) is the stage between the expected cognitive decline of normal aging and the more serious decline of dementia. It can involve problems with memory, language, thinking, and judgment that are greater than normal age-related changes.
- *Proprioception* - perception or awareness of the position and movement of the body.
- *Proprioceptors* - a sensory receptor which receives stimuli from within the body, especially one that responds to position and movement.
- *Static stretching* - holding a stretch without movement, usually only at the end range of a muscle.
- *Symmetrical load bearing* - the use of tactile feedback, auditory cues, and visual cues to facilitate therapeutic improvements
- *Unstable surface training* - the use of unstable surfaces such as hills and valleys, flexible mats Bosu Balls to challenge the body's joints and reactions to loss of balance
- *Vestibular System* - the vestibular system is a sensory system that is responsible for providing our brain with information about motion, head position, and spatial orientation; it also is involved with motor functions that allow us to keep our balance, stabilize our head and body during movement, and maintain posture
- *Visual Feedback* - a method used in rehabilitative practices where the attention of the patient is focussed on a mirror placed in front of them while they perform their exercises
- *Visual System* - The visual system comprises the sensory organ (the eye) and the part of the central nervous system which gives organisms the ability to process visual detail as sight, as well as enabling the formation of several non-image photo response functions.

Section 4: Types of Exercise to Incorporate

Walking is the easiest way to improve stamina, endurance, and improve strength, has been shown to improve the brain's resistance to Alzheimer's disease and mild cognitive impairments, and also to reduce memory loss over time. Walking is an exercise activity that most people can participate in, as it is low impact and does not require a special setting or any equipment.

A study performed at Massachusetts General Hospital reports the highest brain health benefits in people who walked 8,900 steps per day, which is approximately 4.5 miles

per day. This study suggests that walking reduces the cortical thinning associated with the buildup of amyloid plaques and preserves gray matter in areas of the brain that are associated with memory loss and the related neurodegeneration.

In the early stages of Alzheimer's the gait pattern often appears well preserved. However, it is evident that a slow or decreased walking pace is significantly associated with an increased risk for dementia and cognitive decline. Gait adjustments in patients with Alzheimer's disease have been explained by frontal lobe dysfunctions, especially in the motor cortex, and by a decrease in **executive functions**. Upon observing the patients' gait, special attention should be paid to notice if there is a decline in the stride, stance phase, or decreased speed in walking that is not connected to a clear cause such as arthritis, injury, or stroke. Patients should be cued to increase walking pace, improve stride, improve cadence as needed, and any declines should be noted.

There are several tests to gauge walking speed and quality, including the 10 meter Walking Test. This test can be used to detect variations and monitor improvement or decline in gait speed. This test is begun by measuring and marking a 10-meter walkway. A mark should be added at 2 meters and at 8 meters. The patient walks without assistance 10 meters (32.8 feet) and the time is measured for the intermediate 5 meters (19.7 feet) to allow for acceleration and deceleration.

- The therapist should start timing when the toes of the leading foot cross the 2-meter mark.
- The therapist should stop timing when the toes of the leading foot cross the 8-meter mark.
- Assistive devices can be used but should be kept consistent and documented from test to test.
- If physical assistance is required to walk this test should not be performed.
- It can be performed at the fastest speed possible or preferred walking speed but should be kept consistent and documented appropriately.
- Normal values that should be compared are the following (Ten Meter Walk Test, 2014);

Age	Male, meters per second	Female, meters per second
20-29	1.36	1.34
30-39	1.43	1.32

40-49	1.43	1.39
50-59	1.43	1.31
60-69	1.32	1.24
70-79	1.26	1.13
80-89	0.97	0.94
90-99	0.97	0.94

- To calculate gait speed, use the equation of total distance/ time.
- The values provided in the above chart are not indicative of everyone's gait speed. This test should be performed three times, then averaged, to find the appropriate gait speed for each specific patient. This test can be performed to gauge changes in gait speed and monitor.

In a case study of 23 people with Alzheimer's disease, with 12 patents in the training group, 11 patients in the control group. Eleven patients without Alzheimer's disease were also included in this group, titled the healthy group The training group participated in a physical activity program for four months. The control group and health group were instructed not to participate in any kind of regular physical activity during this period. The training group activity program included motor activities and cognitive tasks simultaneously, with the participants attending a one-hour session three times per week. Gait parameters were analyzed under two conditions, before and after the physical activity program, during single and dual-task activities. The purpose of this study was to identify the effects of aging and Alzheimer's disease on gait parameters with the inclusion of the four-month program of physical activity with emphasis on cognitive components on gait during single and dual tasks.

The multimodal exercise intervention consisted of several modalities, such as strength and resistance training, aerobic capacity, flexibility, balance, and agility, while also focusing on cognitive activities requiring focused attention such as the planned organization of the answers, abstraction, motor sequencing, judgment, behavioral self-control and mental flexibility. For example, patients were instructed to carry out a motor task such as bouncing a ball, walking, or exercising with resistance, while at the same time carrying out a cognitive task such as generating words according to semantic criteria, such as animal names, fruit names, personal names, or names of flowers or figures. During the intervention, the complexity of the tasks increased. The

cognitive overload was assigned according to previous experience and was carried out by increasing the level of difficulty of the task.

It was discovered that regardless of the type of gait, either gait alone or dual-task with cognitive obstacles, the individuals who participated in the exercise program presented increased stride length, stride velocity and cadence, and decreased stride duration. This shows that walking alone increases the gait performance of patients with Alzheimer's. The improvement in mobility after an intervention may be explained by the various changes in the structure and physiology of the brain, such as increases in **brain volume** and the **hippocampal volume**, in brain-derived neurotrophic factor and **insulin-like growth factor**. Physical activity contributes to the health of neural activity in relation to the **frontal cognitive functions**. When performing gait training, it is important to keep track of the patient's gait speed and quality. Encourage the patient to take normal steps, monitoring step height and stride length as well as balance while walking.

There are many ways to incorporate strength training into a seniors activity schedule. Researchers at the University of Sydney conducted a clinical trial for older patients at high risk of Alzheimer's disease due to mild cognitive impairment. Participants in this study participated in supervised strength training for 90 minutes in total each week, for a two to three week period. The team conducted an MRI brain scan of the participants three times over an 18 month period and used advances in image analysis to quantify changes to subregions within the hippocampus. Research showed that strength training can protect some hippocampal subregions from degeneration or shrinkage for up to 12 months after stopping training.

Strength training can be assimilated into the exercise program by adding exercises such as;

- Free weight training - the use of weights to perform exercises. Single-arm rows, bicep curls, lying chest presses, overhead presses, tricep extensions, shoulder squats, front raises, shoulder flexion, and shoulder extensions can all be performed while holding weights. Patients should be advised to use weights that they can feel but which are not so heavy they cannot perform more than eight reps at a time. They should be monitored to avoid pain, as if the exercise hurts weights should be lowered. It is obvious that the weight is too heavy if the patient has to arch the back or swing the body to lift the weight.

- Leg strength training can include such exercises as leg presses, use of an exercise bike, resisted knee flexion, resisted hip extension, resisted hip flexion, and resisted hip abduction and adduction. The use of weights or therapeutic bands is encouraged.
- Some general exercises include lying hip bridges, squats, wall pushups, heel and toe stands, standing marching, standing or lying hip abduction and adduction, chair squats, knee lifts with a med ball, step-ups onto a stair, hamstring curls, seated lateral rotation for the core,
- Water exercises are a great strength training idea due to the fact that water provides a low impact, low weight-bearing exercise. It reduces the foot striking forces that so often jar the muscles, ligaments, tendons, and bones, lessening the burden of exercise on the body. Water provides some low resistance on a more stable level, which exercises the muscles better than common standing exercises on land. It is easier for patients to perform lunges and other exercises that may upset their balance. When in water, please provide adequate support and supervision to avoid accidents.
- The use of machine-assisted exercises such as the aforementioned leg presses or use of exercise bikes, use of a step machine, lateral pull-down machine, rowing machines, elliptical machines, cable strength machines, treadmills, and stair-step machines.

Tai Chi is a Chinese martial art which has been practiced for generations. Over the years, it has been adapted for various purposes including training for sports and for defense. Common elements in all forms of Tai Chi include concentration on breathing, slow and deliberate movements, and meditation. It is repetitive and easy to learn and follow. Tai Chi has become a popular trend as an exercise for seniors, with emphasis on breathing correctly and focusing on how they intake and release air while moving. Tai Chi is beneficial for seniors with Alzheimer's disease and offers many advantages;

- Improves balance by incorporating side-stepping and conscious weight shifts, which reduces falls in elderly adults. Studies show that people who are afraid of falling are much more likely to fall, and the calming effect of Tai Chi builds confidence and can decrease the rate of falls.
- Strengthens muscles in the legs.
- Increases flexibility and stability.
- Improves core strength to enhance stability and reduce back pain.
- Concentration on movement helps the mind to relax and relieves stress.
- When performed in groups promotes social interaction.

When utilized with seniors who have Alzheimer's, it is important to implement short blocks of exercise. This is encouraging for seniors who have dementia as they are easy to follow. Tai Chi is chair friendly, and is often performed in such a way to encourage those who cannot safely perform the movements standing. This makes Tai Chi a safe and fun program, which is easy to stick to so that adherence is maximized.

Several studies have shown that Tai Chi can help people with Alzheimer's and dementia. Tai Chi has positive effects on memory, as the breathing techniques are purported to build inner muscle and mental strength. The breathing increases oxygenation and blood flow to the brain and increases heart rate variability which affects cognitive areas of the brain in a constructive manner. There are brain imaging studies in humans that show Tai Chi can enhance brain physiology and memory. The best activities to improve memory involve learning a skill. Tai Chi has been shown to improve cognitive function, and with the ease of use for Alzheimer's disease patients is a great tool for improvement.

Research also suggests that yoga and meditation may help in prevention and improving symptoms. Yoga and meditation assimilate breathing, movement, postures, chanting, visualization, and focus, which can stimulate **neuroplasticity** and **neurogenesis**. Chronic stress and the related stress hormones negatively affect the brain. Stress can kill brain cells and reduce the size of the brain and has a shrinking effect on the prefrontal cortex which is the area of the brain responsible for memory and learning, and on the hippocampus which is important for memory and cognition. Stress disrupts synapse regulation, resulting in the loss of sociability and the avoidance of social interactions with others. Yoga can reduce stress hormones and teach patients to cope with the stress of their lives. Meditation and yoga have shown to slow atrophy of the brain. It has also been shown that the **default mode network** in the brain experiences greater neural connectivity in those who meditate.

Yoga is not appropriate for patients with osteoporosis or issues with dizziness. It can be a great challenge to the seniors' balance so a therapist should be present and provide hands-on contact to avoid falls. Some yoga poses that can be performed are;

- *Balancing mountain pose* - the patient is positioned in standing with feet hip-width apart and arms relaxed at sides with palms facing forward. While pushing into the floor with your toes, lift both heels as high as possible. Finding a focal point to help balance, breathe in this pose for three to five breaths. This is similar to toe raises

for strengthening exercises. To make it more difficult instruct the patient to lift their arms toward the ceiling as they lift their heels.

- *Seated mountain pose* - with the patient in seated exhibiting a straight spine and proper posture. As the patient exhales, instruct them to push down into the chair with their bottom. The legs should be at 90-degree angles with knees directly over feet. A few inches of room should be present between the knees. Instruct the patient to take a deep breath and as they exhale, roll the shoulders down the back, pull in the belly button towards the spine, and relax the arms. Legs can be engaged by lifting the toes and pressing the sole of the feet firmly into the floor.
- *Standing knee to chest* - with feet hip-width apart and hands-on-hips, roll the shoulders up, back, and down. The lower belly should be sucked in as the chest lifts. Instruct the patient to lift one knee to hip height while keeping hands on the hips. Help them to find a focal point to help balance and breathe here for three to five breaths. This can also be performed in a seated position. Repeat with the other leg.
- *Warrior I* - starting in seated mountain pose, instruct the patient to take a deep breath. As they inhale, lift the arms out to sides then raise their hands up to meet above the head. Lacing the fingers together while keeping the pointer fingers and thumbs out, so that the patient is pointing at the ceiling directly over the head. As the patient inhales, they should roll the shoulders away from the ears, letting the shoulder blades slide down the back. At this position, take five deep breaths before exhaling and letting the arms float gently back to the sides.
- *Seated forward bend* - patient should begin in a seated mountain, and inhale while the spine is extended. Instruct the patient to lean forward slowly while sliding the hands down the thighs into a folded position. Five or more breaths should be taken while in this position, to lengthen the spine and stretch the back muscles. As the torso is lifted back into an upright position, the patient should inhale.
- *Warrior III Variation* - Standing in the mountain pose, the patient should lift the left foot behind them and slowly tip the torso forward, allowing the left leg to extend as they do so. Keep in contact with a gait belt to avoid falls from overbalancing. With the left foot flexed and toes pointing to the floor, the patient should find a focus point and breathe at this point for a few breaths. Repeat on the opposite side.
- *Golden Lion Shakes its' Mane* - The patient should begin a seated position, upright, with hands resting lightly on the thighs. The patient should be breathing deeply and comfortable, and on the exhale, lean forward until the stretch can be felt in the lower back. As they near the end of the range of forward motion, they should twist the shoulders to one side, allowing the head and neck to turn with the shoulders and spine. The patient should inhale slowly as they twist back toward facing forward and

sit up to the starting position. On the next exhalation, repeat the motion, only turning to the opposite side. The movement should be reversed again on the inhale, returning to the starting position.

These are just a few poses to help begin focus and stretch the body. There are many poses available which should be tailored to the patient while keeping safety in mind. Seated exercises may be most appropriate for patients who are in the advanced stages of Alzheimer's. It is important to prioritize safety to avoid falls which can be dangerous to those of advanced age. Falls are to be avoided with all seniors, but more so with those who suffer from dementia due to the trauma negatively impacting cognitive function in those with Alzheimer's, and the increased difficulty with mobility that would be a consequence.

Section 4 Summary

Exercises that focus on strengthening, balance, mobility, flexibility, and functional ability are most beneficial to Alzheimer's patients. Tai Chi and yoga are often utilized due to the slow-moving, repetitive, relaxing motions involved. Gait should be monitored and observed during the Physical Therapy process with proper documentation performed to ensure that stride length, step height, and balance continue to be appropriate for the patient's safety. Exercise is important in those with Alzheimer's disease to improve and maintain balance and stability, endurance, and flexibility. It has been shown to positively impact mood, promote blood flow around the body, and of course to build muscle strength. When exercising with seniors who have cognitive impairments, it is important to implement short blocks of exercise, keep the exercise simple and easy to follow, and to keep them interested and motivated to ensure adherence and short term attention. Music, exercise videos, group activities, and games can be incorporated to assist with the enjoyment factor. Patients who suffer from dementia are more likely to be agreeable to do an activity that they feel is enjoyable, or that is engaging in some way.

Section 4 Key Concepts

- *Brain volume* - The adult human brain weighs on average about 1.5 kg (3.3 lb). In men, the average weight is about 1370 g (3.02 lbs), and in women the average about 1200 g (2.6 lbs). The volume is around 1260 cm^3 in men and 1130 cm^3 in women, although there is substantial individual variation. As the body ages, brain

atrophy occurs, which results in dementia, seizures, loss of motor control, and difficulty with speaking, comprehension or reading

- *Default mode network* - A system of connected brain areas that show increased activity when a person is not focused on the outside world. Involved in activities like daydreaming or thinking about the past and future.
- *Executive function* - Executive function and self-regulation skills depend on three types of brain function: working memory, mental flexibility, and self-control. These functions are highly interrelated, and the successful application of executive function skills requires them to operate in coordination with each other.
- *Frontal cognitive functions* - The frontal lobe of the brain is vital to our consciousness, as well as functions that appear uniquely human, such as spoken language. It is one of four paired lobes in the brain's cerebral cortex, and it plays vital roles in memory, attention, motivation, and numerous other daily tasks.
- *Hippocampal volume* - The volume associated with the hippocampus, which is a brain structure embedded deep in the temporal lobe of each cerebral cortex. It is an important part of the limbic system, a cortical region that regulates motivation, emotion, learning, and memory.
- *Insulin-like growth factor* - Insulin-like growth factor (IGF), formerly called somatomedin, any of several peptide hormones that function primarily to stimulate growth but that also possess some ability to decrease blood glucose levels.
- *Neurogenesis* - Neurogenesis is the process by which nervous system cells, the neurons, are produced by neural stem cells.
- *Neuroplasticity* - The brain's ability to reorganize itself by forming new neural connections throughout life. Neuroplasticity allows the neurons (nerve cells) in the brain to compensate for injury and disease and to adjust their activities in response to new situations or to changes in their environment.

Summary

Although there is no known cure for Alzheimer’s disease, Physical Therapy and other clinical treatments can help to manage and improve the symptoms of this disease. Physical therapy can help to improve strength, increase flexibility, improve gait, enhance functional ability, restore balance, and provide a great social interaction opportunity. A regular exercise program is important to increase endurance and blood flow to the body, and lessen the risks of falls. It is also important because it can be difficult for seniors to maintain mobility, resulting in muscle atrophy, weakened joints, decreased range of motion, and declining energy levels. Research has shown

that physical activity can improve brain function and memory, may delay the onset of Alzheimer's disease, and may delay a decline inability to perform tasks in Alzheimer's patients by improving strength, balance, safety, and gait patterns. Walking is the easiest way to improve stamina, endurance, and strength, and has been shown to improve the brain's resistance to Alzheimer's disease and mild cognitive impairments. It is a wonderful way to promote activity as no special equipment or setting is necessary, and it is low impact for those with limited strength and poor joints. Gait speed, stance time, quality, and stride should be observed when with the patient to monitor for decline and dysfunction. When exercising, the practitioner should remember to include cues for the visual, auditory, and tactile senses in symmetrical load bearing to help enforce and ingrain these cues in multiple ways to assist the patient in remembering. Mirrors are helpful to provide visual cues and to assist with correcting improper form. Therapists should utilize the cognitive tests such as the Clock Drawing Test, the Mini-Cog test, the Six Item Cognitive Impairment Test, the Self Administered Gerocognitive Exam, and the Abbreviated Mental Test Score to gauge the severity of cognitive decline and monitor the progression of the disease. When exercising, it is important for the Therapist to keep the exercises simple, repetitive, fun, engaging, and safe. With this in mind, programs that include Tai Chi, meditation, or yoga can be beneficial to motivate the patient and help keep them calm and learn breathing exercises to assist with frustration management. Problem-solving skills are compromised in those with Alzheimer's, which makes it all the more important to avoid difficult exercises. Physical Therapists should be encouraged to implement music, videos, or group sessions to keep the exercise sessions interesting and appealing to the patient, as they can be easily distracted. The clinician must never make assumptions about the patients' ability to perform or communicate, as this disease affects every patient differently. Each patient should be evaluated and treated as an individual with personally tailored sessions. The patient should never be excluded from discussions with family and should be included in decision making if at all possible. For those who have more difficulty with problem solving and communication, the Therapist should maintain eye contact and speak slowly and clearly. Be patient in conversation and with exercise treatments, giving the patient time to respond and react. Directions should be provided in a clear, step by step manner. In the later stages of this disease, tactile and visual cues are more important. A regular exercise program can also improve mood and promote social interaction, which can significantly benefit the patients' overall wellbeing.

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